

FIG. 1  
Prior Art

FIG. 2A

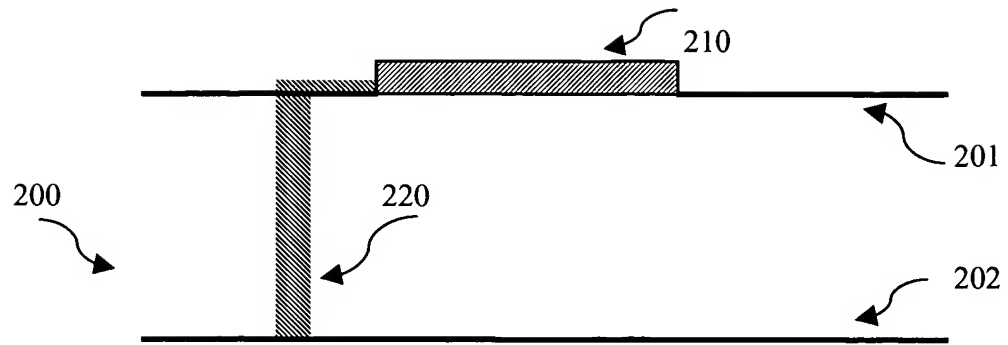


FIG. 2B

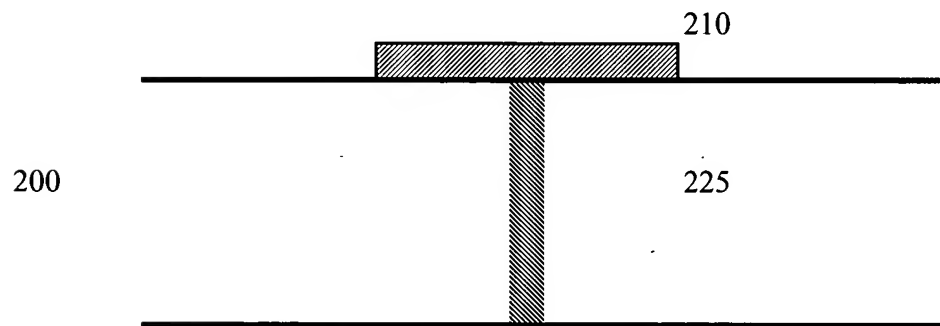


FIG. 3A

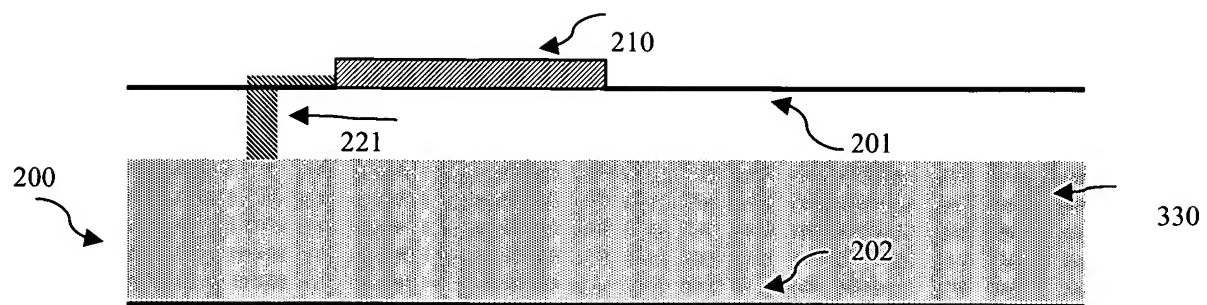


FIG. 3B

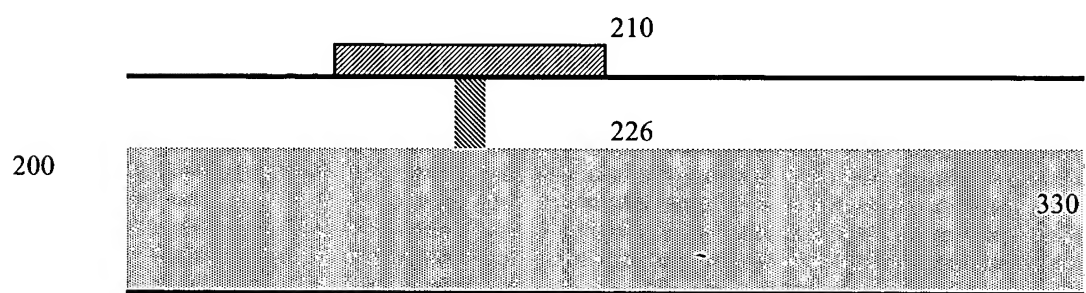


FIG. 4A

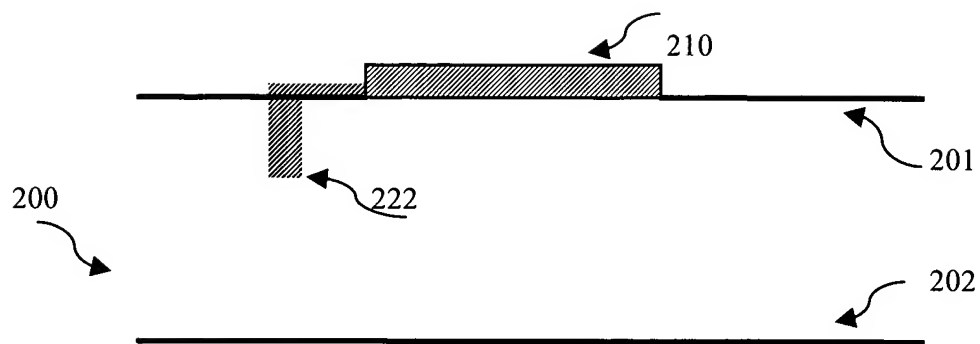


FIG. 4B

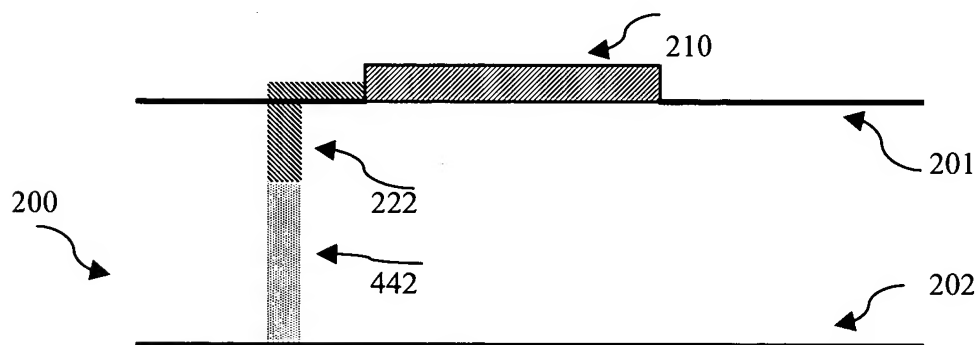


FIG. 4C

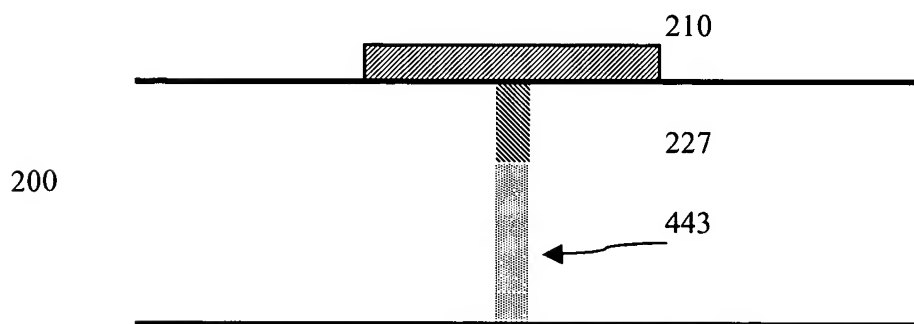


FIG. 5A

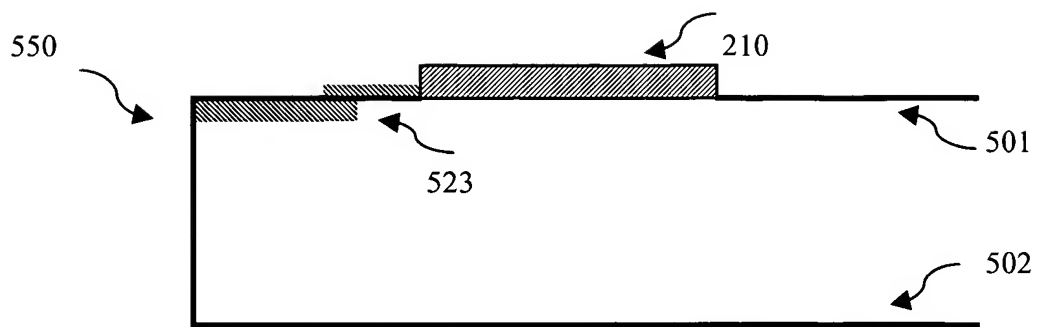
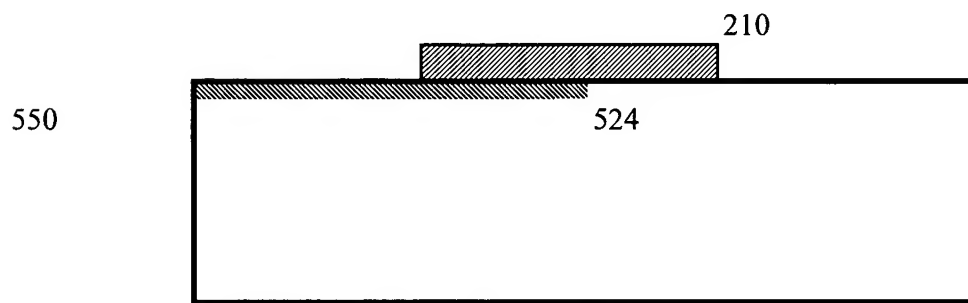


FIG. 5B



**FIG. 6**  
**Exemplary Process Steps for forming channels in a wafer.**

*(After completion of the active circuit components and first layer metallization and simultaneous with the beginning of the first layer of copper metallization.)*

- 1 Apply channel mask & open pattern for channel etch.
- 2 Remove material from channel regions to desired depth, using RIE for example.  
(This may be through an interlevel dielectric layer as well.)
- 3 Remove photo resist & prepare for next step.
- 4 Define Cu metal pattern in ILD layer.
- 5 Deposit Cu barrier material on channel interior surfaces & ILD surfaces.
- 6 Deposit Cu seed material in channel regions and for Cu metallization, as required.
- 7 Deposit Cu metallization.
- 8 Remove excess Cu with CMP or as appropriate.

(At this point the channel region is treated as another vertical via for each succeeding metallization step.)

Nth The wafer processing is completed.

(Prior to singulation sufficient material is removed from the back of the wafer to expose the channels from the front side by CMP or other process.)